Chapter 1
Introduction to the Document

This is the first part of a two-part document. This volume contains a summary and synthesis of the recent literature relevant to the science and management of freshwater wetlands. Volume 1 describes what the scientific literature says about:

- How environmental factors control the functions of wetlands across the landscape and at individual sites, how freshwater wetlands are classified according to these controls, and what functions are performed by different classes of wetlands in the state
- How human activities and land uses affect the environmental factors that control wetland functions
- How disturbances caused by human activities and land uses impact the performance of functions by freshwater wetlands
- How wetlands are protected and managed using common tools such as buffers and compensatory mitigation
- How cumulative effects result from the current use of these tools

The second volume will translate these scientific findings into options and recommendations for policies and regulations that can be used to protect and manage wetlands.

This work is being collectively prepared by the Washington State Department of Ecology (Ecology), the Washington State Department of Fish and Wildlife (WDFW), and a private consultant. The U.S. Environmental Protection Agency (EPA) funded and assisted in its production. Representatives from these agencies, as well as staff from the private consultant, made up a team (the Core Team) that guided the project. See Appendix A for a list of Core Team members.

Both volumes will be of use to all those interested in protecting and managing wetlands. They will find these documents useful in gaining a greater understanding about the current science of the ecology, function, and management of freshwater wetlands. Examples of user groups include federal, state, and tribal staff; planners; resource managers; wetland scientists; builders; farmers; environmentalists; and other concerned citizens.

One key group involved in wetland protection in the State of Washington is local governments. Through the Growth Management Act (RCW 36.70A) every county and city in Washington must identify and inventory critical areas (including wetlands) within their boundaries and protect them. In 1995, an amendment to GMA

(RCW 36.70A.172[1]) required that all city and county governments rely on best available science (BAS) when developing their critical areas policies and regulations.

WAC 365-195-900 provides assessment criteria to assist in determining whether information constitutes the best available science. To be best available science, scientific information must be produced through a valid scientific process. A valid scientific process is one that produces reliable information that is useful in understanding the consequences of regulatory decisions and in developing policies and regulations that will be effective in protecting the functions and values of wetlands and other critical areas.

Appropriate sources of scientific information as defined in WAC 365-195-900 include:

- Research
- Monitoring
- Inventory
- Survey
- Modeling
- Assessment
- Synthesis
- Expert opinion

Information derived from one of these sources can be considered scientific information if it possesses the required characteristics shown in WAC 365-195-900. See Appendix B for characteristics of a valid scientific process and a description of the common sources of scientific information as listed and defined in WAC 365-195-900.

Volume 1 meets the definition and characteristics required for a synthesis. Findings from scientific journal articles, government publications, technical books, and other sources that meet the definition and characteristics of BAS in WAC 365-195-900 were used and referenced in the synthesis. Conference proceedings, personal communications, and other "gray" literature were occasionally used and in some cases had not been peer reviewed. Reviewers of Volume 1 are asked to judge the reliability of the sources we used, including any gray literature.

In some cases we have cited unpublished data collected during the calibration of the Washington State Wetland Function Assessment Methods and the Washington State Wetland Rating System. These data have not been published in scientific journals. However, the assessment methods and the wetland rating system, which the data support, have been peer reviewed.

This synthesis, which is undergoing broad peer review, may be of special interest to local governments that do not have the resources to complete their own review of the scientific literature. Local governments should, however, also consider locally and regionally specific information not included in this synthesis if such information meets the

characteristics of a valid scientific process and is one of the specified sources of scientific information described in Appendix B.

1.1 Scope of Volume 1

The scope of this project, and the information in the synthesis, is limited to freshwater wetlands of Washington State. It does not address streams or riparian areas that are not wetlands. We do however summarize literature related to stream buffers.

Marine and estuarine systems were excluded primarily to keep the scope of the project in the range of the available funding. Some recent scientific information on coastal and estuarine wetlands has been summarized by WDFW, Ecology, and other agencies through the Aquatic Habitat Guidelines Project, which is available on the internet (www.wa.gov/wdfw/hab/ahg).

The effects of growing cranberries is wetlands are also not covered in this document because of the time and funding constraints of the project and the limited area of the state that is affected by cranberry production. In addition, information related to the effects of silviculture and forest practices on forested wetlands is not included because this subject is being addressed in another document currently being developed (Cooke in press).

In addition, the synthesis in Volume 1 is limited to information that has a practical application to the management and protection of freshwater wetlands. For the most part, available documents from the past 10 years were used as the primary sources for this report. It was assumed that this most recent literature would incorporate relevant science from the preceding years. Older documents were used in instances where they had not been superseded by more recent studies.

> This volume DOES NOT contain agency recommendations or suggestions for implementation. Any recommendations provided in Volume 1 (for instance, in the section of Chapters 5 and 6 addressing buffers and compensatory mitigation) are those that have been described in the literature and are included here only as part of the synthesis of existing scientific information.

1.2 Overview of Volume 1

Volume 1 is organized into seven chapters. The chapters share a common organization, beginning with a reader's guide that describes the topics covered in the chapter and how the chapter is organized. An introduction then provides general background information, definitions, and clarifications. Each chapter describes how well the subject is documented in the literature, particularly for the Pacific Northwest. The chapters note data gaps where adequate or appropriate literature on an issue could not be found. Key

points are summarized at the end of major sections and conclusions provided at the end of each chapter.

A brief summary of the contents of each chapter and the appendices follows. In the synthesis page numbers are assigned to each chapter individually and are not sequential. For example, there are seven page number 3s, one for each chapter (1-3, 2-3, 3-3, etc).

Chapter 1 – Introduction to the Document

Chapter 1 describes the purpose and background for this synthesis and the many groups that may find the information useful. It describes how it relates to requirements under the Growth Management Act that local governments include "best available science" when developing and revising ordinances for critical areas including wetlands. It gives a brief synopsis of the intent and summarizes the organization of Volume 1. The methods used to prepare and review Volume 1 are provided in Appendix C at the end of the document.

Chapter 2 – Wetlands in Washington and How They Function

Chapter 2 summarizes the science regarding how wetlands function in Washington State. It describes how functions are defined and introduces the concept that the performance of functions is controlled by a number of environmental factors within the wetland boundary (site scale) as well as in the broader landscape (landscape scale). The chapter then describes how some of the key factors that control functions are used to classify wetlands into groups that perform functions in similar ways.

The chapter goes on to describe 15 functions of freshwater wetlands in Washington. Where applicable, the chapter discusses the differences in functions among wetland classes and in various areas of the state. The major functions described are those that were defined for the Washington State Function Assessment Methods (Hruby et al. 1999, 2000).

Chapter 3 – Environmental Disturbances Caused by Different Human Activities and Uses of the Land

In Chapter 3, the discussion shifts from wetland functions and the environmental factors that control the performance of functions to the major disturbances created by human activities and uses of the land and water. In this context, a *disturbance* is an event that changes an environmental factor that controls wetland functions. Ten disturbances are identified such as changing the amount of sediment and increasing the concentration of salt. A description of the movement of water on the landscape and thresholds at which impervious surfaces impact aquatic resources, general disturbances to the quality of water, and general disturbances to connections between habitats is provided.

The chapter continues with separate sections for four major types of human land uses in Washington State (agriculture, urbanization, logging, and mining) and how they create disturbances. For each of these four land uses, several types of disturbances that change the factors controlling wetland functions are discussed, including (as applicable):

- Changing the physical structure within a wetland (e.g., filling, removing vegetation, tilling soils, compacting soils)
- Changing the amount of water in wetlands (increasing or decreasing the amount)
- Changing the fluctuation of water levels (frequency, amplitude, direction of flow)
- Changing the amount of sediment (increasing or decreasing the amount)
- Increasing the amount of nutrients
- Increasing the amount of toxic contaminants
- Changing the acidity (acidification)
- Increasing the concentration of salt (salinization)
- Decreasing the connection between habitats (fragmentation)
- Other disturbances (noise, etc.)

Chapter 4 – Impacts of Human Disturbances on the Functions of Wetlands

Chapter 4 integrates the concepts discussed in Chapter 2 and Chapter 3. Chapter 2 described the functions performed by wetlands and the environmental factors that control these functions. Chapter 3 discussed the major disturbances caused by different human activities and uses of the land. Ten sections, one for each of the disturbances listed above, summarize how these disturbances ultimately leads to impacts on hydrologic functions, functions that improve water quality, and habitat functions.

Chapter 5 – The Science and Effectiveness of Wetland Management Tools

Chapter 5 presents a synthesis of what the current literature reports on four tools currently used to address impacts to wetlands and their functions: wetland definitions, wetland delineation methods, wetland ratings, and buffers. In the section on definitions, biological versus regulated wetlands (including "prior converted"), small wetlands, and those that are isolated are discussed. This chapter does not provide language or recommendations for regulatory or policy language—those will be provided in a separate volume on management options and recommendations (Volume 2).

Chapter 6 – The Science and Effectiveness of Wetland Mitigation

Chapter 6 discusses another commonly used wetland management tool, compensatory wetland mitigation. This topic is discussed in its own chapter because of the large volume of literature available on this subject. Topics covered in this chapter include:

- Evaluation of the success of compensatory mitigation
- Compliance of mitigation projects with permit requirements

- Types of compensatory mitigation
- Replacement ratios and replacement of wetland acreage
- Functions provided by compensatory mitigation projects
- Reproducibility of particular types of wetlands (bogs, fens, vernal pools, alkali wetlands, and mature forested wetlands)
- Suggestions from the literature for improving compensatory mitigation

Chapter 7 - Cumulative Impacts on Wetlands

Chapter 7 describes how the current wetland management approach of protecting resources parcel by parcel can lead to inadequate protection of wetlands. It discusses some reasons given by researchers for the difficulty in assessing cumulative impacts.

The chapter summarizes the recommendations by numerous researchers for ways to manage aquatic resources on a landscape level rather than case by case. Watershed planning and zoning, assessment and selection of restoration sites, floodplain restoration, and other topics are discussed.

Glossary

The glossary provides definitions of technical terms used throughout Volume 1.

References

The references cited in the text are listed in a separate section at the end of Volume 1. Some of these references represent overviews in which a researcher describes trends observed from numerous studies conducted in previous years; in these cases, the reference list includes only the overview document and not all of the previous studies (unless those previous studies were actually reviewed by the Core Team). Similarly, where Volume 1 quotes a literature source and the quotation includes a citation to another author's work, that citation is included in the reference list only if the Core Team actually reviewed it.

Portions of Adamus et al. (2001), a review of current scientific literature on the impacts of human activities on wetlands and their functions, were adapted where relevant into Chapter 4 with permission from Dr. Adamus. The list of cited references at the end of the document includes the literature sources from those portions of Adamus et al. (2001) that were adapted.

The authors are aware that the list of cited references is not consistently formatted and abbreviations are used. This has resulted from various problems with the database used to generate the list. Correcting these problems with the database requires significant time and effort. The Core Team decided to publish the draft with these imperfections, while striving to include all citations made in the text of the document.

Appendices

The appendices of Volume 1 are as follows:

- Appendix A identifies the team guiding the production of Volume 1 (the Core Team).
- Appendix B describes the characteristics of a valid scientific process and types of scientific information defined by the Washington Administrative Code.
- Appendix C details the methods used in the literature review and production of Volume 1.
- Appendix D is a placeholder where those who comment on this draft of Volume 1 will be listed in the final version of this document.
- Appendix E provides information about various terms and methods that have been used to organize and group information about wetlands, such as classification, characterization, rating, etc.

1.3 Methods for Preparing and Reviewing Volume 1

The primary steps taken to arrive at publication of this document include:

1. Searching the literature
2. Reviewing, sorting, and prioritizing the reference lists
3. Obtaining the reference documents
4. Reading and entering notes on the documents in a database
5. Writing and revising the text
6. Obtaining peer and public review
7. Responding to comments, revising the text, and completing the document

With the distribution of this draft, step 6 is currently underway.

Given the scope of this project and the volume of existing information on wetlands, each of these steps has entailed a lengthy process. The processes used for these steps, including the scientific databases and the key words used to search them, are described in Appendix C.

1.4 Public Involvement Process for Volume 1

1.4.1 Public Involvement Process

The public involvement process for Volume 1 included several mailings and focus group meetings. Ecology compiled a mailing list of experts, local government planners, and other groups and individuals from various existing mailing lists compiled for other wetland-related projects.

In October 2001, Ecology sent out a focus sheet describing the project and a cover sheet that solicited the recipient's participation in the project. This sheet included a tear-off card that could be used to request that the sender be retained on the mailing list. The mailing list was then edited based on the returned cards.

Focus group meetings were held in January 2002 in Moses Lake and Olympia to begin to gather public input for the project. These meetings were attended by various Core Team members, local planners, other local government staff, and other interested parties. The purpose of these meetings was to help focus the project so that the synthesis reports meet the needs of local governments. The meetings gave opportunities to the Core Team to present information on the project and to listen to questions and concerns from the attendees. Keyword lists were revised based on focus group input.

In June 2002, Ecology sent out a mailer with a project update to the entire mailing list, discussing the status of the project, changes in the timeline, changes in deadlines for critical area ordinance revisions, and other issues.

In November 2002, Ecology staff contacted selected experts in various disciplines to solicit their review. The list of peer reviewers was not intended to be inclusive of all experts. The purpose was to make sure that each of the major topics in Volume 1 was reviewed by one or more recognized experts in that discipline.

In February 2003, Ecology sent another mailing to all those on the list to determine who wanted to comment on the draft of Volume 1. In June 2003, Ecology distributed a notice via email to update the public on revised target dates for distribution of the draft document for peer and public review.

1.4.2 Current Public Review Process

The draft of Volume 1 has been posted on the Ecology web site and reviewers are encouraged to download the document. The draft was also mailed directly to those who requested a CD or paper copy. Experts are reviewing the document at the same time as local government and agency staff, interested organizations, and the public.

Commentors are asked to complete a questionnaire and submit detailed comments six weeks after it has been distributed. A deadline for submitting comments is provided in instructions that accompany this document. Ecology staff will collect the questionnaire

and written comments, organize them, and present them to the Core Team for discussion. Authors will revise the text of Volume 1 accordingly.

Volume 1 is available online

Ecology has developed a home page for this project on the Shorelands and Environmental Assistance Program web site. The home page includes a project description, contact information, current status of the project, and copies of all the updates that were sent. The "current status" section of the home page is updated periodically. The web page also includes a copy of this draft Volume 1. See the instructions for this document for the address of the web site.

1.5 Conclusions

Volume 1 provides a summary of relevant scientific literature related to freshwater wetlands in the Pacific Northwest and their management. The document will be useful to all those who have an interest in the management and protection of wetlands including agency staff, consultants, interested organizations, and citizens. It will be particularly helpful to local governments who are required under the Growth Management to include best available science when developing and revising regulations protecting critical areas including wetlands. Volume 1 will be reviewed by technical experts (peer reviewed) and any other interested parties. The intention of the project and the review process is to produce a synthesis of the current science on freshwater wetlands that is easily understood, yet thorough and scientifically rigorous.